

A redescription of *Torymus sapporoensis* Ashmead and description of a new species of *Torymus* Dalman (Hymenoptera: Torymidae) parasitizing *Paratephritis fukaii* (Diptera: Tephritidae) in Japan

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Abstract

Torymus itoi Matsuo **sp. nov.** (Hymenoptera: Torymidae) is described as a parasitoid of *Paratephritis fukaii* Shiraki (Diptera: Tephritidae) which induces galls on the petioles and peduncles of *Farfugium japonicum* (L.) Kitam. (Asteraceae) in Japan. Torymid specimens that were previously identified as *T. sapporoensis* Ashmead in Ito (1947) are identical with *T. itoi*, which is shown to be different from *T. sapporoensis*. To complement the insufficient original description, *T. sapporoensis* is redescribed based on the holotype.

Key words: *Torymus itoi*, fruit fly, *Farfugium japonicum*, gall

Introduction

The genus *Torymus* Dalman (Torymidae: Toryminae) contains about 400 species worldwide of which 14 have been recorded from Japan (Grissell 1995; Noyes 2003; Matsuo & Yukawa 2009a, 2009b). Previously, six species were known to attack fruit flies in the Holarctic Region (Grissell 1995; Graham & Gijswijt 1998). Fruit flies include many pest species that infest a wide variety of fruit, particularly in tropics and subtropics. Therefore, taxonomic studies of their parasitoids, such as torymids, are essential in their control.

Farfugium japonicum Kitam. (Asteraceae) is a perennial plant, which is distributed in Japan (except Hokkaido), Taiwan, and eastern parts of China (Iwatsuki *et al.* 1995). *Paratephritis fukaii* Shiraki (Diptera: Tephritidae) lay eggs into young petioles or peduncles of *F. japonicum* and induce elongated spindle-shaped galls that contain more than one larva (Higashi *et al.* 1990; Yukawa & Masuda 1996). This fruit fly species is known to occur in Japan except Hokkaido and the Southwestern Islands (Yukawa & Masuda 1996). *Paratephritis fukaii* has two or more generations a year in Kagoshima Prefecture, Kyushu, Japan (Higashi *et al.* 1990).

In 1944, Dr. S. Ito reared parasitic wasps from galls of *P. fukaii* in Fukuoka Prefecture, Kyushu, Japan, which were deposited in the collection of the Entomological Laboratory, Kyushu University, Fukuoka, Japan (ELKU). The specimens were identified by Dr. K. Yasumatsu as *Torymus sapporoensis* Ashmead (Hymenoptera: Torymidae) and *Eurytoma japonica* Ashmead (Hymenoptera: Eurytomidae) (Ito 1947). The specimens in ELKU likely were used by Dr. Yasumatsu for his identification of *T. sapporoensis*, though the name of the person who was responsible for the identification was not indicated on the label. *Torymus sapporoensis* was described by Ashmead (1904) based on a single female collected by Dr. S. Matsumura from Sapporo City, Hokkaido, Japan. The original description of *T. sapporoensis* and the label attached to the holotype do not give any information on its host or associated plant. It is possible that the host and associated plant of *T. sapporoensis* occur elsewhere than Hokkaido, but no other specimens have been found in major parasitoid collections in Japan, such as the Kamijo collection in the Hokkaido University Museum and the Tachikawa collection in the Entomological Laboratory of Kyushu University. In addition to this

negative evidence, there is a tendency towards mono- or oligophagous habits among torymids whose host ranges have been clarified (Askew, 1965; Grissell 1976; Graham & Gijswijt 1998). For these reasons I doubted the identification by Dr. K. Yasumatsu of the torymid species attacking *P. fukaii* in Kyushu as *T. sapporoensis*, particularly because both *P. fukaii* and its host plant, *F. japonicum*, are not present in Hokkaido, the type locality of *T. sapporoensis* (Iwatsuki *et al.* 1995; Yukawa & Masuda 1996).

In 2007 and 2008 adults of a *Torymus* species were reared from the galls of *P. fukaii* collected from Kagoshima Prefecture, Kyushu. These and the specimens reared by Dr. Ito were compared with the holotype female of *T. sapporoensis* deposited in the collection of the United States National Museum of Natural History (USNM), Washington, DC, USA. Morphological comparison of the specimens indicated that those reared from the galls of *P. fukaii* on *F. japonicum* in Fukuoka and Kagoshima Prefectures are identical to each other, but different from *T. sapporoensis*. Further study revealed that the species attacking *P. fukaii* is new to science. The purpose of this paper is to describe this new species and to redescribe *T. sapporoensis* based on the holotype because its original description is inadequate for taxonomic studies.

Material and methods

A total of 100 spindle-shaped galls were collected from *F. japonicum* on 20 July 2007, 22 October 2008, and 5 November 2008 from Daizaka, Kinpo, Minamisatsuma City, Kagoshima Prefecture. In addition, 4 galls were collected from Kamitakakuma, Kanoya City, Kagoshima Prefecture on 24 October 2008. These galls were kept in plastic bags (38 cm in height, 32 cm in width, 0.02 mm in thickness) kept at room temperatures (15–20°C). Adults that emerged from the galls were preserved in 75% ethanol. To prepare the specimens for observation under a binocular microscope, they were transferred from ethanol to isopropyl alcohol, in which they were kept for at least eight hours, and then in xylene for five minutes (Matsuo & Yukawa 2009b). Thereafter, the specimens were air dried and point mounted.

Adult morphological terminology follows Gibson (1997) except additional head characters follow Janšta & Bouček (2006).

Results

Torymus itoi Matsuo, sp. nov.

Figs 1–8

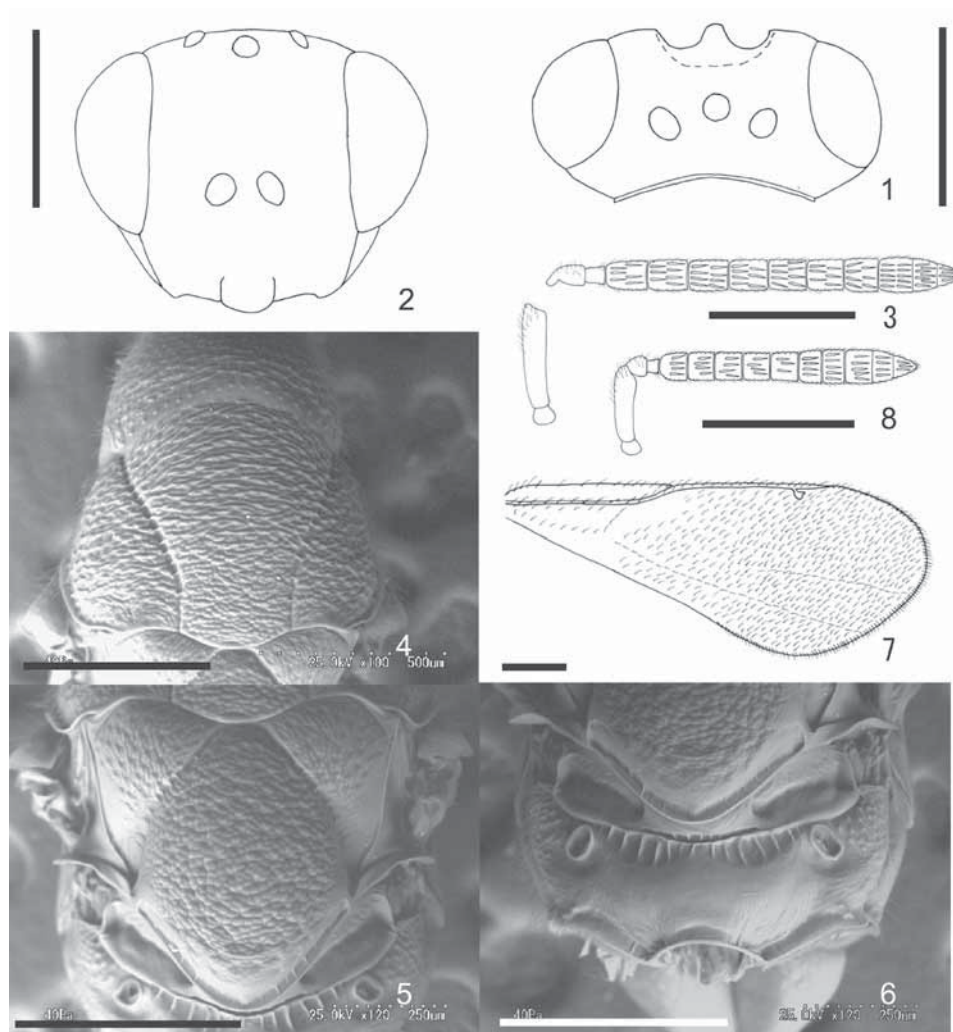
Torymus sapporoensis Ashmead; Ito, 1947: 98–99, 101. Misidentification.

Etymology. The specific name honors Dr. Syusiro Ito who first reared this species from galls of *P. fukaii*.

Type material. Holotype (ELKU, Type No. 3291). ♀, emerged on 27 July 2007 from a gall of *Paratephritis fukaii* on *Farfugium japonicum* collected by J. Yukawa, K. Tsuda and K. Matsuo on 20 July 2007 in Daizaka, Kinpo, Minamisatsuma City, Kagoshima Prefecture, Japan.

Paratypes (ELKU). 11 ♀, 8 ♂ paratypes as follows: 2 ♀ and 4 ♂, same data as holotype; 1 ♀, emerged on 28 July 2007 from a gall of *P. fukaii* on *F. japonicum* collected by J. Yukawa, K. Tsuda and K. Matsuo on 20 July 2007 in Daizaka, Kinpo, Minamisatsuma City, Kagoshima Prefecture; 1 ♀ and 2 ♂, emerged on 6 November 2008 from a gall of *P. fukaii* on *F. japonicum* collected by T. Yamaguchi on 22 October 2008 in Mt. Kinpo, Kinpo, Minamisatsuma City, Kagoshima Prefecture; 7 ♀ and 2 ♂, emerged on 19 and 21 June 1944 from galls of *P. fukaii* on *F. japonicum* collected by Syusiro Ito from Kyudai-Kasuya-Ensyurin (= the Research Institute of Kyushu University Forests, Sasaguri Town, Fukuoka Prefecture, Japan.).

Description. FEMALE. Body length excluding ovipositor sheaths 3.4–4.8 mm. Head bluish green. Scape brownish yellow with apical tip darker; pedicel and all flagellomeres black. Mesosoma bluish green. Wings hyaline. Fore coxa yellowish brown; mid coxa yellowish brown ventrolaterally; hind coxa concolorous with mesosoma; all femora and tibiae yellowish brown; claws brown. Metasoma bluish green with coppery tint.



FIGURES 1–8 *Torymus itoi* Matsuo, **sp. nov.** 1, ♀ head, dorsal view; 2, ♀ head, frontal view; 3, ♀ antenna; 4, ♀ mesoscutum; 5, ♀ scutellum; 6, ♀ propodeum; 7, ♀ forewing, upper surface; 8, ♂ antenna. Scale lines: 0.5 mm.

Head 2.0–2.2x as wide as long in dorsal view (Fig. 1); temple 0.20–0.22x longer than dorsal length of eye, straight; POL 1.7–1.9x OOL; OOL 1.1–1.3x OD. Head 1.1–1.2x as wide as high in frontal view (Fig. 2); eyes separated by their height; malar space 0.37–0.40x height of eye; mouth 1.9–2.0x malar space; gena curved; torulus situated 1.3–1.6x its own diameter above ventral margin of eye; clypeus with apical margin rounded; mandible with three teeth. Antenna (Fig. 3) not clearly clavate; scape 0.67–0.72x as long as height of eye, just reaching ventral margin of anterior ocellus; combined length of pedicel and all flagellomeres 1.4–1.5x width of head; pedicel 1.7–1.9x as long as wide; anellus quadrate; F1 1.5–1.7x as long as wide, slightly longer than pedicel; F2–F5 1.3–1.6x longer than wide; F6 1.1–1.3x longer than wide; F7 quadrate; each segment bearing longitudinal sensilla arranged in two rows; apical clavomere (C3) with a small tuft of micropilosity beneath.

Mesosoma 1.8–2.0x as long as wide; mesoscutum (Fig. 4) with small piliferous punctures; sculpture on mesoscutum in anterior half transversely reticulate, in posterior half scaly reticulate; notaulus complete, distinct; scutellum (Fig. 5) 1.3–1.4x as long as wide, sculptured as posterior part of mesoscutum; dorsellum without median carina; propodeum (Fig. 6) with superficial striae, smoother medially; lower mesepimeron 1.1–1.3x as long as wide. Forewing (Fig. 7) 2.4–2.6x as long as wide; costal cell 11.0–13.4x as long as wide, on upper surface with a setal row sparse in middle, on lower surface with a complete setal row and scattered setae; basal cell closed, with a row of setae below submarginal vein; speculum narrowly open below; relative length of marginal vein: postmarginal vein: stigmal vein = 10.6: 2.4: 1.0; stigmal vein weakly petiolate. Hind coxa 1.8–2.1x as long as wide, angulate anteriorly, with dorsal carina at base; dorsal surface of hind coxa with

short setae in basal half; hind femur 4.1–4.5x as long as wide; hind tibia with longer spur 1.2–1.4x as long as width of hind tibia, 0.3–0.4x length of basitarsus; shorter spur 0.6–0.7x length of longer spur.

Metasoma as long as mesosoma plus head; posterior margin of metasomal tergum five emarginate; tip of hypopygium situated at about 0.7 length of metasoma, with short setae; ovipositor sheath as long as metasoma plus three-fourths length of mesosoma, 2.9–3.2x as long as hind tibia.

MALE. Differs from female as follows: Body length 2.2–3.3 mm. Temple 0.26–0.30x longer than apparent length of eye. Antenna (Fig. 8) stouter than that of female; scape bluish green, not reaching anterior ocellus; pedicel quadrate; F1–F5 quadrate; F6–F7 transverse; longitudinal sensilla on each segment arranged in one row. Relative length of marginal vein: postmarginal vein: stigmal vein = 8.7: 2.2: 1.0. Hind tibia with spur longer, 0.4–0.5x length of basitarsus.

Distribution. Japan (Kyushu).

Host insect. *Paratephritis fukaii* (Diptera: Tephritidae).

Associated host plant. *Farfugium japonicum* (Asteraceae).

***Torymus sapporoensis* Ashmead, 1904**

Figs 9–12

Torymus sapporoensis Ashmead, 1904: 82–83. Holotype ♀, Japan, Hokkaido, Sapporo City (USNM, type no. 7145). Examined.

Redescription of holotype. FEMALE. Body length excluding ovipositor sheath 3.3 mm. Head bluish green. Scape brownish yellow with apical tip darker; pedicel dark brown with greenish tint; all flagellomeres dark brown. Mesosoma bluish green. Wings hyaline. Fore coxa yellowish brown; mid and hind coxa concolorous with mesosoma; all femora and tibiae yellowish brown; claws brown. Metasoma with bluish tint dorsally.

Head 2.1x as wide as long in dorsal view (Fig. 9); temple 0.23x longer than dorsal length of eye, straight; POL 2.3x OOL; OOL 1.2x OD. Head 1.1x as wide as high in frontal view (Fig. 10); eyes separated by their height; malar space 0.31x height of eye; mouth 2.1x malar space; gena straight; torulus situated 1.2x its own diameter above ventral margin of eye; clypeus with apical margin rounded. Antenna (Fig. 11) not clearly clavate; scape 0.67x as long as height of eye, reaching anterior ocellus; combined length of pedicel and all flagellomeres 1.5x width of head; pedicel 1.5x as long as wide; anellus transverse, 1.6x as wide as long; F1 1.6x as long as wide, longer than pedicel; F2–F5 1.6–1.7x longer than wide; F6 1.4x longer than wide; F7 1.2x as long as wide; each segment bearing longitudinal sensilla arranged in two rows; apical clavomere (C3) with a small tuft of micropilosity beneath.

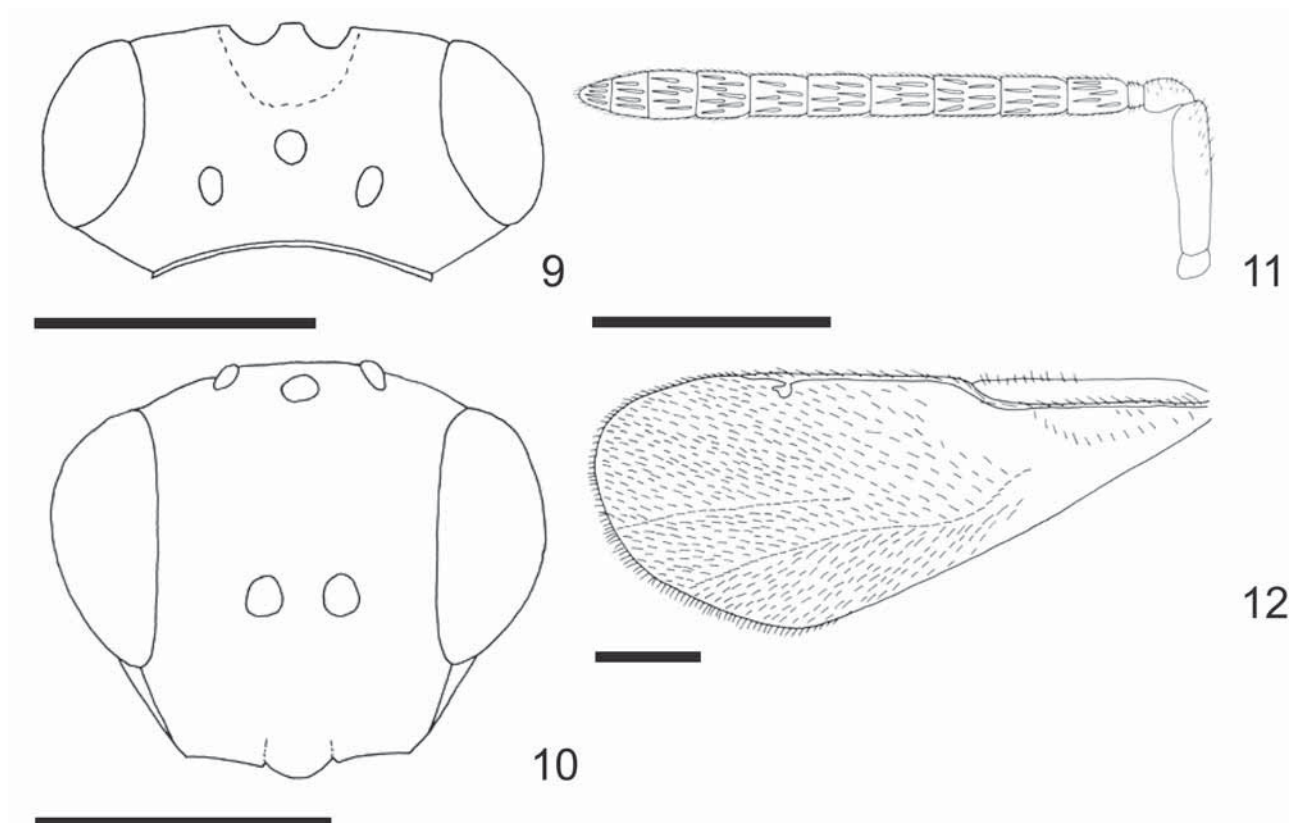
Mesosoma 1.9x as long as wide; mesoscutum with small piliferous punctures; sculpture on mesoscutum in anterior half transversely reticulate, in posterior half scaly reticulate; notaulus complete, shallow; scutellum 1.3x as long as wide, sculptured as posterior part of mesoscutum; dorsellum without median carina; propodeum with superficial striae; lower mesepimeron 1.5x as long as wide. Forewing (Fig. 12) 2.4x as long as wide; costal cell 10x as long as wide, on upper surface with a setal row in distal half, on lower surface with a setal row and scattered setae apically; basal cell closed, with a few setae; speculum open below; relative length of marginal vein: postmarginal vein: stigmal vein = 12.5: 3.0: 1.0; stigmal vein weakly petiolate. Hind coxa 2.0x as long as wide, angulate anteriorly, with dorsal carina at base; dorsal surface of hind coxa with setae in basal half; hind femur 4.8x as long as wide; hind tibia with longer spur 1.5x as long as width of hind tibia, 0.5x length of basitarsus; shorter spur 0.7x length of longer spur.

Metasoma as long as mesosoma; posterior margin of metasomal tergum five emarginate; tip of hypopygium situated at about 0.8 length of metasoma, with short setae; ovipositor sheaths as long as combined length of metasoma plus two-thirds of mesosoma, 2.6x as long as hind tibia.

MALE. Unknown.

Distribution. Japan (Hokkaido).

Host. Unknown.



FIGURES 9–12 *Torymus sapporoensis* Ashmead (♀). 9, head, dorsal view; 10, head, frontal view; 11, antenna; 12, forewing, upper surface. Scale lines: 0.5 mm.

Discussion

I consider that the torymid specimens identified by Dr. K. Yasumatsu as *T. sapporoensis* in Ito (1947) are identical with *T. itoi* in all morphological characters examined; however, based on comparison with the holotype, *T. itoi* is different from *T. sapporoensis*. According to the key to species groups and species of *Torymus* by Graham & Gijswijt (1998), both *T. itoi* and *T. sapporoensis* belong to the *T. bedeguaris*-group based on the following features: piliferous punctures on mesoscutum small; scutellum wholly sculptured; hind coxa not elongate, dorsally with setae in basal half; hind tibia with two apical spurs; forewing hyaline; speculum present. *Torymus itoi* can be distinguished from *T. sapporoensis* by the combination of the following features: notaulus distinct rather than shallow; propodeum with superficial striae but smoother medially; anellus and F7 of antenna quadrate rather than transverse; gena curved rather than straight; ovipositor sheath longer, 2.9–3.2 times as long as hind tibia as compared to 2.6 times.

Among other members of the *T. bedeguaris*-group, *T. itoi* is most similar to *T. aceris* because of the following shared features: hind coxa with short carina dorsally; ovipositor sheath as long as metasoma plus three-fourths length of mesosoma; and tip of hypopygium with several short setae. *Torymus itoi* can be distinguished from *T. aceris* by the following features: sculpture on mesoscutum in anterior half transversely reticulate; temple straight; F2–F6 longer than wide; F7 quadrate; anellus of male quadrate; and hind femur color of male yellowish brown. *Torymus sapporoensis* is similar to *T. arcella* Graham and Gijswijt (1998) of the *T. bedeguaris*-group because of the following shared features: notaulus shallow; dorsellum without median carina; and gena straight. However, *T. sapporoensis* can be distinguished from *T. arcella* by the combination of the following features: ovipositor sheath shorter; longitudinal sensilla of flagellomeres arranged in two rows; F1–F7 longer than wide; combined lengths of pedicel and all flagellomeres relative to head width longer; and tip of hypopygium with setae.

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References

- Ashmead, W.H. (1904) Descriptions of new Hymenoptera from Japan – I. *Journal of the New York Entomological Society*, 12, 65–84.
- Askew, R.R. (1965) The biology of the British species of the genus *Torymus* Dalman (Hymenoptera: Torymidae) associated with galls of Cynipidae (Hymenoptera) on oak, with special reference to alternation of forms. *Transactions of the Society for British Entomology*, 16, 217–232.
- Gibson, G.A.P. (1997) Chapter 2. Morphology and terminology. In: Gibson, G.A.P., Huber, J.T. & Woolley, J.B. (Eds.), *Annotated Keys to the Genera of Nearctic Chalcidoidea (Hymenoptera)*. NRC Research Press, Ottawa, pp. 16–44.
- Graham, M.W.R.deVere & Gijswijt, M.J. (1998) Revision of the European species of *Torymus* Dalman (Hymenoptera: Torymidae). *Zoologische Verhandelingen, Leiden*, 317, 1–202.
- Grissell, E.E. (1976) A revision of Western Nearctic species of *Torymus* Dalman (Hymenoptera: Torymidae). *University of California Publications in Entomology*, 79, 1–120.
- Grissell, E.E. (1995) *Toryminae (Hymenoptera: Chalcidoidea: Torymidae) a Redefinition, Generic Classification, and Annotated World Catalog of Species*. Memoirs on Entomology, International, Associated Publishers, Gainesville, 474 pp.
- Higashi, M., Yukawa, J., Hosoyamada, S. & Kiyokawa, I. (1990) Changes in the age structure of *Paratephritis fukaii* Shiraki (Diptera: Tephritidae). *Proceedings of the Association for Plant Protection of Kyushu*, 36, 195–197. (In Japanese with English summary.)
- Ito, S. (1947) *Paratephritis fukaii* et sua galla (Trypetidae, Diptera). *Collecting and Breeding*, 9, 97–98, 101. (In Japanese.)
- Iwatsuki, K., Yamazaki, T., Boufford, D.E. & Ohba, H. (1995) *Flora of Japan Volume IIIb Angiospermae Dicotyledoneae Sympetales (b)*. KODANSHA LTD, Tokyo, Japan, 196 pp.
- Janšta, P. & Bouček, Z. (2006) A new species of *Eridontomerus* with taxonomic and faunistic notes on some other taxa (Hymenoptera: Chalcidoidea: Torymidae). *Acta Entomologica Musei Nationalis Pragae*, 46, 211–218.
- Matsuo, K. & Yukawa, J. (2009a) Host insect records and distributional information for *Torymus* species (Hymenoptera: Torymidae) in Japan. *Japanese Journal of Environmental Entomology and Zoology*, 20, 133–135. (In Japanese with English summary.)
- Matsuo, K. & Yukawa, J. (2009b) Two new species of *Torymus* Dalman, 1820 (Hymenoptera: Torymidae) parasitizing *Celticis japonica* Yukawa & Tsuda, 1987 (Diptera: Cecidomyiidae) that induces leaf galls on *Celtis* species (Ulmaceae) in Japan. *Entomological Science*, 12, 261–269.
- Noyes, J.S. (2003) *Universal Chalcidoidea Database*. World Wide Web electronic publication. Available from: <http://www.nhm.ac.uk/research-curation/projects/chalcidoids/> (accessed 2 September 2009).
- Yukawa, J. & Masuda, H. (1996) *Insect and Mite Galls of Japan in Colors*. Zenkoku Nôson Kyôiku Kyôkai, Tokyo, Japan, 826 pp. (In Japanese with English explanation for color plates.)